CENIDE & WIN Seminar Series on 2D-MATURE

DFG IRTG 2803 & NSERC CREATE

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“Physics with a new type of 1D metal”

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10:00 a.m. ET / 16:00 p.m. CET

Thomas Michely is professor for experimental physics at the II. Physikalisches Institut of Universität zu Köln, Germany. He synthesizes nanostructures and 2D materials and investigates their structural, electronic, and magnetic properties. Key methods of his research are scanning tunneling microscopy and -spectroscopy. He studied physics at the University Bonn where he received his PhD in 1991. He has been working at the Research Center Jülich (until 1997) and at RWTH Aachen (until 2006). In 1994 he stayed at the IBM T.J. Watson Research Center with a Feodor-Lynen-Fellowship and from 1997-2001 he was a Heisenberg-Fellow of the German Science Foundation (DFG). His own work, but also the work of his students won several prizes, among them the Wayne B. Nottingham Prize, the Gerhard Ertl Young Investigator Award, and the Gaede Preis. He authors more than 200 publications and holds 2 patents. His work received 16700 citations with an H-index 63 (google scholar).

A mirror twin boundary in a single layer of MoS_2 is an extremely well insulated straight wire with a diameter below 1 nm. The one-dimensional (1D) band linked to the wire originates from the necessity to compensate polarization charge arising at discontinuities in the polar MoS_2. Using scanning tunneling spectroscopy, we determine the polarization charge to be 2/3 of an electron per unit cell along the boundary in full agreement with theoretical predictions. While mirror twin boundaries are obstacles for transport normal to them, they can successfully be applied as ultimately thin gates in field effect transistors.

On the fundamental side, mirror twin boundaries can be used to construct a new type of Kondo system, for which the entire spectral function is resolved, including the impurity levels underlying the resonance. Using this information, with the help of numerical renormalization group calculations one is able to test the predictive power of the Anderson model with high accuracy.

A second topic addressed is the use of molecular beam epitaxy to overcome the limitations set by the approach of creating 2D materials through exfoliation from bulk crystals. While a rich world of new 2D materials opens, we exemplify for the case of Cr_xS_y 2D materials the difficulties to determine the structure of the material and how density functional theory may lay out misleading traces.